

DRAFT

Mr. Doug Demko
S.P. Cramer & Associates, Inc.
386 Brookside Dr.
Chico, CA 95928

Dear Mr. Demko:

I am writing in support of the Stanislaus River Weir Proposal submitted by S.P. Cramer & Associates, Inc.

The San Joaquin River Management Program provides a forum to identify problems and solutions to issues related to wildlife, flood protection, water quality, water supply, fisheries, and recreation. The SJRMP Action Team and Advisory Council have reviewed and discussed this project, and support the effort to improve the understanding of salmonid populations in the Stanislaus River.

The Advisory Council is in support of the project proposed by S.P. Cramer & Associates, Inc. and understands that this project will provide accurate estimate information necessary in fishery management and habitat restoration in the San Joaquin River system.

The 1995 San Joaquin River Management Plan recommends many projects and studies to address issues related to fisheries in the San Joaquin River system. This recommendation is based upon providing valuable information to interested parties, and increasing their ability to understand the fish habitat in the river system.

If you have any questions in this regard, please call Paula Landis at (559) 230-3310.

Sincerely,

Timothy Ramirez, Chair
San Joaquin River Management Program
Advisory Council

**SUPPORTING
DOCUMENTATION
IS ON THE
FOLLOWING PAGES**



S.P. Cramer & Associates, Inc.

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August 30, 2001

Marty Kjelson
4001 North Wilson Way
Stockton, CA 95205

RE: Request for CV Team Conceptual Support of Weir Project

Dear Mr Kjelson,

This letter is to request the Central Valley Salmonid Project Work Team (CV Team) to review a proposal to operate a portable resistance board weir (i.e. Alaskan Weir) on the Stanislaus River. In evaluating the proposal the group should consider whether the proposal addresses significant management issues which would increase our understanding of salmonid populations, and if the methodology and planning demonstrate that there is a reasonable likelihood that the project would accomplish its stated objectives.

The proposal is being submitted to CalFed for possible funding in September, and I would like to add the CV Team to the list of supporters. I am seeking only conceptual support of the project on the Stanislaus River, since sampling details will be determined prior to weir operation through a facilitated process with the USFWS, NMFS, CDFG, and the Salmon Escapement Project Work Team. If the CV Team has recommendations or concerns they would like addressed, please provide documentation of them and I will see that they are addressed in the proposal, or during the planning process prior to weir operation.

Thank you for consideration of this matter. Please call if you have questions or comments.

Sincerely,

via e-mail

Doug Demko

PROPOSAL

ADULT CHINOOK AND STEELHEAD ENUMERATION AND BIOLOGICAL EVALUATION IN THE STANISLAUS RIVER USING A PORTABLE RESISTANCE BOARD WEIR

August 29, 2001

Prepared by

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Stanislaus River Weir Proposal

Introduction

Accurate estimates of adult salmon escapement are key to valid assessments of stock status and effective protection or recovery efforts. Biased estimates of abundance can result in significant errors in fishery management and faulty assessments of the needs for water management, habitat restoration, or other measures (Walters and Ludwig 1981, Rivard 1989, Hilborn and Walters 1992, Hinrichsen 2001). Uncertainty in fish status can also necessitate more conservative management to buffer the risks associated with the uncertainty, especially for sensitive fish stocks protected by the Federal Endangered Species Act (ESA). Costs associated with errors and uncertainty in stock assessment can be significant. In recent years, large amounts of effort and money have gone into salmonid restoration throughout the state. However, the effectiveness of restoration actions is difficult to judge because there is no way to directly enumerate adult salmon in the most California tributaries where hatcheries do not exist.

Adult chinook salmon escapement in most Central Valley tributaries is currently inferred using conventional carcass mark-recapture methods (Boydston 1994, Law 1994). This method involves recovering spawned-out carcasses, marking with jaw tags, and distributing back into the stream. The streams are then surveyed weekly during the spawning season, and the rate of disappearance from the previous week's tagged carcasses is used to estimate sampling efficiency. Total abundance is estimated from carcass surveys based on observed numbers of marked and unmarked carcasses.

Carcass-based abundance estimates require a series of underlying assumptions regarding random distribution of tagged carcasses and tag recovery effort, carcass visibility, and tag retention. Assumptions are largely untested but can substantially affect the accuracy of abundance estimates (Ricker 1975, Seber 1982, Cavallo 2000). The accuracy of the estimates is influenced by factors such as surveyor experience, weather, flow, turbidity, canopy cover, time of day, pool to riffle ratio, sinuosity, water depth, density of fish, channel morphology, fish behavior, and other biases that cannot be assessed. It is also unclear how the technique for placing carcasses back in the stream affects the probability of disappearance before the next survey. Surveyors release the marked carcasses in the middle of the stream to mimic a dying fish, but carcasses naturally tend to collect in specific locations in each stream and whether tagged carcasses relodge in the stream in a manner similar to dying fish is problematic. The time between each survey can also affect the recapture rate of carcasses, and most statistical techniques recommend more frequent surveys (every 3-5 days), which can be difficult to accomplish and expensive.

At a recent Central Valley spawner escapement workshop, representatives from CDFG, NMFS, and DWR agreed that they have low confidence in the accuracy of spawning surveys (by current methods), and new systems are urgently needed that will enable managers

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to confidently estimate run sizes. The accuracy of abundance estimates based on carcass mark-recapture can be estimated by comparison with known numbers of fish (Simpson 1984; Shardlow et al. 1987). If accuracy could be estimated and biases were detected, correction factors could be developed for application to future sampling and also to historic data. However, published studies describing the accuracy of mark-recapture estimates of salmon escapement are scarce (Cousens et al. 1982).

Recently, a CDFG and NMFS Joint Hatchery Review Committee conducted a review of state-wide hatchery practices in California, and made specific recommendations to improve management of Central Valley stocks. One recommendation demonstrates an understanding by the agencies of the need to recover marked fish, and to accurately assess current escapement procedures, and reads:

All agencies should pursue efforts to develop adequate sampling programs to recover marked fish in the Central Valley. The DFG should establish a process to coordinate and oversee the methodologies for estimating salmon escapements to the Central Valley. (CDFG and NMFS 2001)

Portable resistance board weirs (a.k.a. Alaskan weirs) are an alternative that can provide direct, reliable counts of salmon and other species which can be compared to escapement estimates to determine their accuracy. These weirs are used by state and federal agencies in Alaska and are widely accepted to be an effective and efficient method of enumerating upstream migrants, even during periods of substantial flow fluctuations and debris loading. We propose to evaluate the feasibility of using a portable resistance board weir to determine the total chinook escapement in the Stanislaus River.

Justification

Direct counts provided by a weir would allow us for the first time to accurately determine adult salmon escapement in the Stanislaus River. Direct counts would provide a means of validating carcass survey results, estimating the uncertainty in those estimates, and developing a correction factor for estimates, should there be differences in actual and estimated abundance. All estimates of naturally spawning salmon in California are estimated based on carcass survey techniques. Thus, the evaluation of the carcass survey techniques as used on the Stanislaus would provide a basis for evaluating state-wide procedures. If there were a large discrepancy between the actual count and the carcass estimate in the Stanislaus River, managers elsewhere would be alerted to possible problems with their own estimates. Conversely, if Stanislaus escapement techniques are found reliable, similar techniques could continue to be used elsewhere, or at least serve as evidence that other estimates are valid.

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In addition, weir counts would also allow us to collect other critical information on sample sizes which are not provided by carcass surveys, including detailed information on steelhead occurrence, coded wire tags, fish movement patterns, stray rates, survival rates, recruitment rates, and the relative effects of in-basin habitat, water management, and ocean conditions.

This weir project is the only method capable of answering questions concerning the presence of steelhead in the San Joaquin Basin. Unlike salmon, steelhead do not die after spawning and therefore do not show up in carcass surveys, and as a result are not enumerated each year. Although snorkel surveys are able to identify large rainbow trout adults, without direct observation and scale analysis it is impossible to conclusively determine life-history. Weir operation, on the other hand, will provide the timing and number of steelhead migrating into the Stanislaus River. Further, through scale collection and analysis we can determine the life history of each fish captured, and evaluate the relatedness of fish captured in the Stanislaus to stocks in other basins.

A representative sample of scales collected from chinook which could be used to estimate age and growth rates, as well as DNA to determine genetic similarity to other San Joaquin and Sacramento basin stocks. Since each fish could be handled we could also obtain sex and length frequency data, determine the number of jacks (age 2 fish), and look for evidence of disease and previous trauma, such as scarring. Further, the recovery of CWT's in the Stanislaus is currently low. The weir would allow us to estimate the number of CWT's in the run based on the presence of adipose fin clips and to increase recovery rates of CWT's which will in turn increase our ability to estimate survival and stray rates and to relate those rates to specific factors.

One of the most powerful benefits of accurate adult abundance and age composition is the ability to quantify production in terms of recruits per spawner and smolt-to-adult survival rates. These rates (like hatchery CWT groups) enable us to determine what conditions are correlated to good and bad survival, and thus help identify beneficial and detrimental management practices. Accurate escapement estimates would also improve our understanding of juvenile chinook behavior and life history characteristics, which is especially important since the majority of tributaries supporting anadromous salmonids now have screw traps to collect juvenile outmigration data during most of the spring. Accurate adult escapement indices are also the basis for determining ocean harvest rates. This information is difficult to come by for wild stocks, and if successful, the Stanislaus chinook population could be used as a valuable wild stock indicator population.

The Stanislaus River is an ideal location for this work because suitable weir sites are available, its fall chinook are primarily of wild origin, a long time series of adult and juvenile data exists, and other ongoing activities will increase the quantity of information that will be

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provided by weir operations. The low gradient and contained channel of the lower Stanislaus River provide a number of suitable sites where a weir can effectively sample the entire anadromous adult run through its duration. Sites allow for weir operation under varying flows, so even year-round sampling is feasible. Initial feasibility trials are proposed to begin in September, although more extensive operations may be appropriate in the future. In recent years adult fish have been seen spawning in the Stanislaus as early as August, significantly sooner than when carcass surveys begin, and in 2000 there were reports that adults were present near Knights Ferry as early as June.

The Stanislaus fall chinook population is large and consists almost entirely of natural origin fish. Excellent return data is widely available in other systems where hatcheries are present but escapement estimates in wild systems are often confounded by the extended duration of the spawning season and dispersed but nonrandom spatial distribution patterns. Escapement estimates and potential biases in estimates using carcass mark-recapture estimates are heavily dependent on the incidence of hatchery strays. Results in systems where hatchery fish comprise a significant portion of the run may not be applicable to predominately-wild systems.

Extended time series of adult and juvenile sample data are available from the Stanislaus River. Continuous adult data is available since 1940. Juvenile trap data is available since 1993. Direct abundance estimates and other information that could be obtained with a weir would significantly increase our ability to interpret and apply information from these historic datasets.

Other sampling activities in the Stanislaus River also provide a unique opportunity to investigate survival rates and critical factors at different stages in the life cycle. For instance, two downstream rotary screw traps are currently operated - one in the lower river near the mouth at Caswell and another at the head of the low gradient area near Oakdale immediately downstream from key spawning areas. Juvenile abundance and timing information from these two locations, in conjunction with accurate adult numbers, will allow us to partition survival rates and identify key limitations during different life stages. Separate estimates of fry production, fry to smolt survival, and smolt to adult survival can thus be derived for the Stanislaus system. Juvenile trap data currently suggests a complex relationship between spawner, fry, and smolt numbers that may be heavily dependent on flow conditions. For instance, in 1999, 4,500 chinook were estimated to have spawned in the river, compared to 3,147 in 1998, yet catches in downstream screw traps in 2000 (run-year 1999) totaled 120,000 versus 28,000 in 1999 (run-year 1998).

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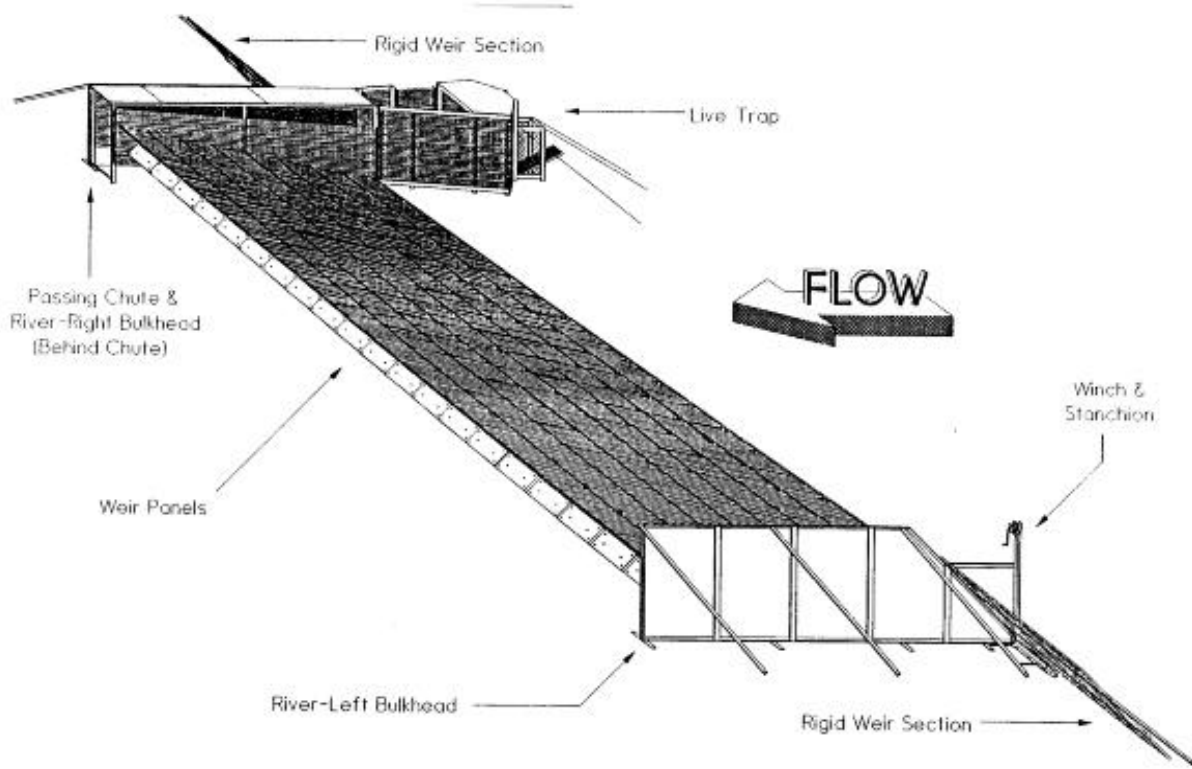
Weir Description

Portable resistance board weirs are a relatively new alternative to other weirs and are capable of consistently providing reliable information in streams that experience debris-laden high water periods (Tobin 1994). Resistance board weirs are more capable than traditional weirs of withstanding high and fluctuating flows, and will temporarily submerge when pressure created by debris loading reaches a point that would wash a traditional weir downstream.

Resistance board weirs are an array of rectangular panels that consist of evenly spaced polyvinyl chloride (PVC) pickets that are aligned parallel to the direction of stream flow. The upstream end of each panel is hinged to a rail that is anchored in the stream bottom, and the downstream end is held at the water surface by a resistance board that planes upward in flowing water (Figure 1). When the panels are installed, the barrier inhibits upstream adult chinook migration while allowing water to pass. Small downstream-floating debris which is impinged against the weir is removed on a daily basis, whereas most larger debris passes over the weir due to its ability to “collapse” under increasing water pressure. Once the debris passes over the weir it returns to its normal operating position. One or more openings in the weir allow fish to be directed into a containment area, or permits them to be counted as they pass through (Figure 2).

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Figure 1. Example of a resistance board weir used by the USFWS in Alaska. (Diagram reproduced from Tobin 1994)



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Figure 2. Photographs of two resistance board weirs in Alaska.

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STATEMENT OF WORK

Objective 1. Provide forum and technical expertise to cooperatively guide the project and perform logistical tasks necessary to construct and operate a weir in the Stanislaus River.

Task 1.1 Establish Stanislaus River weir project steering committee.

Since this project will be the first of its kind in California, we will establish a technical steering committee consisting of agency and private biologists to oversee all aspects of the project. Since the project is designed to evaluate chinook escapement, the newly formed Central Valley Escapement Project Work Team would be the logical choice to serve as the steering committee. The leader of the group has suggested that this would be an ideal role for the group. In addition to the escapement team, we will make sure that at least one representative from CDFG Region IV participates on the steering committee. The group will be responsible for reviewing operation practices, including the final weir design and project implementation plan, as well as ongoing monitoring efforts. In addition to weekly e-mail project summaries, we will present quarterly progress reports to the escapement group and the Stanislaus Fish Group.

Task 1.2 Obtain the necessary state and federal permits to operate the weir and conduct public outreach.

Permitting

Construction and operation of structures, such as the proposed weir, which have the potential of affecting river use and habitat condition are of concern to various agency interests. This project, like the majority of biological monitoring projects designed to enhance critical knowledge of at-risk species, will require navigation of all necessary permitting channels.

Issues of concern associated with the installation and operation of the Stanislaus Weir include impacts on endangered and/or threatened species in the area affected by the project, the hindrance of navigation by boat, alteration of the river bottom and shoreline, and the destruction or removal of riparian vegetation. The permitting process will begin with consultation with the Army Corps of Engineers (ACOE). The ACOE will assess concerns before presenting the project to the necessary agency representatives.

Section 7 consultation with USFWS and NMFS will likely be a requirement during the permitting process of the Stanislaus Weir project. Concerns regarding endangered and threatened animal and plant species including the riparian brush rabbit, riparian woodrat, Swainson's hawk, elderberry bush (USFWS), as well as steelhead and fall-run chinook salmon

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(NMFS) will be addressed accordingly. Within this process, NMFS- designated Essential Fish Habitat may be identified. This will require additional agreements between project leaders and the agency as to the treatment and maintenance of the habitat.

Those issues regarding the navigability of the river at the project location will be addressed and resolved through further consultation with ACOE and subsequent acquisition of a Section 10 (River and Harbors Act) permit. Project organizers have various means for addressing issues of boat passage at the Stanislaus Weir.

Possible effects to the streambed, shoreline, and vegetative habitat in the project area will be assessed prior to and as a result of consultation with ACOE and CDFG. If impacts are found to be significant by investigators representing these agencies, the proper processes for obtaining an ACOE Section 404 (Clean Water Act) permit, as well as a Streambed Alteration Agreement with CDFG will be followed. In addition, should this type of environmental compliance be found to be necessary, consultation with the Regional Water Quality Control Board and subsequent CEQA and/or NEPA approval processes will be followed.

With regards to shoreline, streambed, and riparian vegetation impacts, all legitimate actions and practices during the construction and operation of the weir that will minimize harmful effects to these ecosystem components will be part of project protocol. Such activities include, but are not limited to, minimization of on-shore vehicular traffic at the project site, avoiding the use of fill or the movement of native bank or streambed material during construction, and limiting on-shore activities during weir monitoring to specified areas only.

Avoidance of harmful effects to the terrestrial and aquatic habitat surrounding the Stanislaus Weir study area through various feasible means like the ones mentioned above will aid in the streamlining of the permitting process through the satisfaction of certain environmental policies. In addition, minimization of impacts will make for an all-around more ecosystem-friendly project.

In addition to the various permits and agreements listed above, proper CDFG scientific collection permits will be obtained for all weir study field technicians. Collection permits will include provisions for the collection of salmon and steelhead scale samples.

Public Outreach

Through the permitting process of the weir project many environmental and socio-economic concerns may be raised. Although these concerns can be dealt with through the proper agency notifications, consultations, and approvals, the public will remain a key player in the process. Public outreach will be conducted to inform watershed participants of the

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project functions, goals, and implications. A public meeting will be scheduled upon project approval where landowners, fishermen, recreational river users, and other concerned parties will be informed of project details. Participants will be given time to voice concerns and meet with project leaders. One item of major concern to project management, as well as to agency and public interests is river usage by boaters and how the weir will affect normal usage. Information will be collected from meeting participants via a written survey regarding who uses the river in and around the project location, how often the site is accessed by users, and what type of vessels users are operating. This data will be very important during the process of ACOE Section 10 permitting and will allow project leaders to properly plan and choose options that will allow for normal river usage.

Objective 2. Determine adult chinook salmon and steelhead run timing and abundance in the Stanislaus River.

Task 2.1 Construct and install a portable resistance board weir near the mouth of the Stanislaus River.

Resistance board weir sites are similar to sites described by Clay (1961) and Tobin (1994), and are characterized by wide, shallow stream areas with stable substrate. A site with laminar flow which is relatively straight is preferred, to minimize wear on the weir and prevent bank and bottom erosion.

We are very familiar with the lower Stanislaus River and have spent several days surveying the river to find several suitable locations to install the weir. One possible sight, at river mile 0.3 (Figure 3), is well-suited for several reasons. First, the site is approximately 110 feet wide with a uniform bottom that is a constant depth of 3 feet at 495 cfs. In addition to making fabrication and installation easier, the uniform depth prevents fish from passing under or over the weir by allowing for a uniformly shaped weir that interfaces well with the river bottom. The level river bottom also minimizes problems that can be caused by scouring, which is encouraged by irregular bottoms and securing devices that are necessary in less suitable locations. Recent work conducted on the Noyo River by CDFG suggests that sandy river bottoms may be unstable at high flows, so measures may be necessary to stabilize the weir or prevent scouring when the river rises. The wide river location would help maintain weir integrity and enable it to operate during high flow events by reducing river elevation changes (Figure 4). Further, the location's width would provide adequate area to construct a recovery sight where, after processing, fish can rest and resume their migration at will.

In addition to the site at river mile 0.3, we have identified several other possible sites upstream as far as river mile 9. Each of the sites is conducive to weir construction, with some providing better vehicle access and possible amenities such as electrical power and

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telecommunication access. One significant factor in final site selection is boat traffic. Although the boats will be able to pass over the weir, it is desirable to locate it in an area where boat traffic is minimal, such as immediately upstream from a log-jam. Final site selection will be made after additional surveys are performed, and after meeting with landowners and agency personnel.

Resistance board weirs are known for their ability to withstand significant flow fluctuations, and are designed just for that purpose. Based on average snowpack we expect that flows will be relatively low through fall and winter, although storm events can cause significant changes in flow, and early storms could change forecasted dam operations. However, the weir will be designed to operate at a flow range from approximately 300 to 2,500 cfs, well within the range of expected flows, and within the range of flows experienced in the Stanislaus during the last 3 years (Figure 5). Although the weir will not operate at higher flows, it won't be "blown out." Since flows over 2,000 cfs are typically flash events that only last a few days, we should not miss more than a few days sampling due to storm events that increase flows above 2,500 cfs.

Resistance board weirs are common in Alaska and therefore have been field tested and modified repeatedly. We will use the latest design which will enable boat traffic and large debris to pass over the weir. Although we will use the latest USFWS weir design as a template, the weir will be constructed locally and modified to suit the particular stream site. Although the majority of the weir is made of flexible PVC pipe, some of the critical structural components are made of steel and aluminum. To fabricate these metal parts we will use a machine shop located in Oakdale that has done specialized design and fabrication for us since 1993. Because the shop is located in the river's vicinity, the designers can inspect and conduct repairs on location. The ability to make repairs to equipment (e.g. screw traps) without removing them from the river has saved us considerable time and labor in the past.

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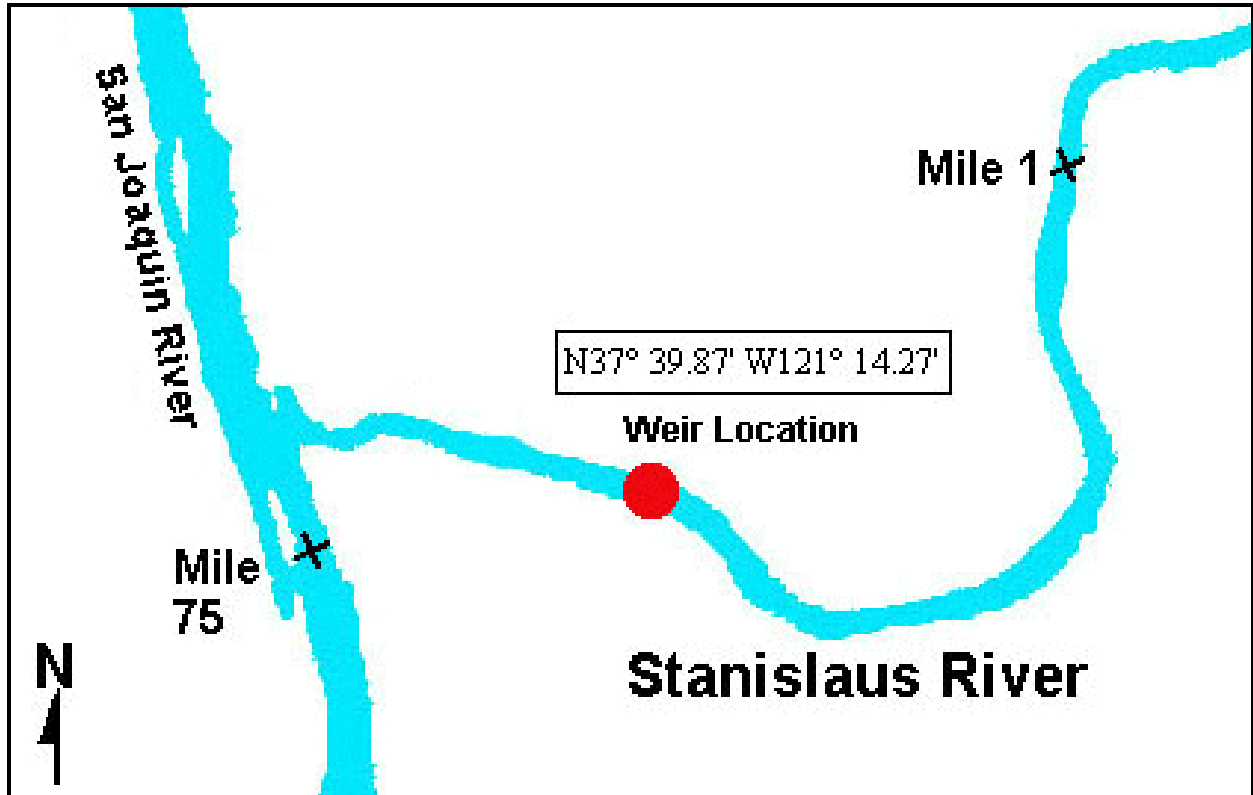


Figure 3. Map of Stanislaus River showing possible weir location relative to the confluence with the San Joaquin River.

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Figure 4. Photograph of Stanislaus River at a possible weir location site. Note the wide river channel and uniform flow and banks.

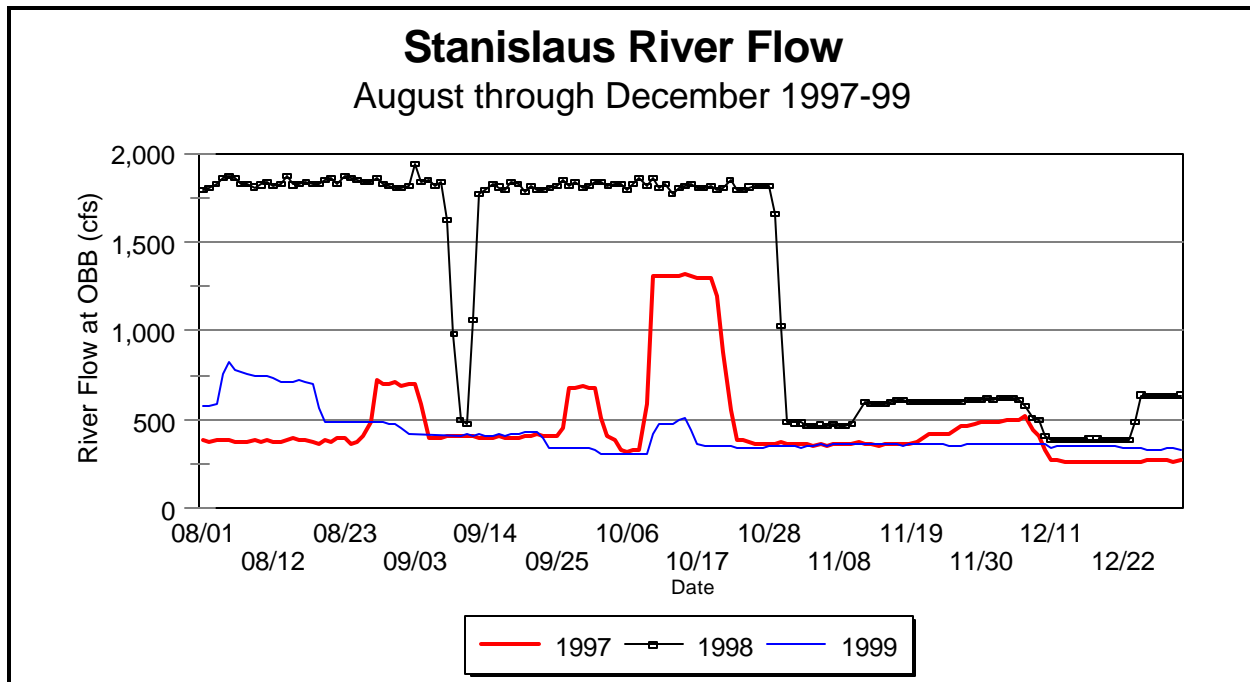


Figure 5. Stanislaus River flow August through December during 1997-1999.

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Task 2.2 Enumerate upstream migrating chinook and steelhead as they enter the Stanislaus River.

The weir design will be such that we will be able to capture and contain all upstream migrating fish. Fish will be contained in a large area with flowing water and will be processed several times per day. To ensure no undue migrational delays the weir will be staffed in the evening and early morning periods, when adults are believed most active, and fish will be processed as they arrive in the containment area. During high abundance periods we will increase staffing to 24 hours per day to ensure that fish are not subject to undue delays or a crowded environment, which could cause unnecessary stress.

Handling procedures will be similar to those developed by the USFWS in Alaska. Prior to the capture of any fish, it will be documented in writing and distributed to local fisheries agencies and the steering committee for review. At the earliest opportunity we will host a field trip such that agencies can independently evaluate the weir and procedures. In case there are periods when fish are too numerous to handle without delay, or for some other reason we wish to count the fish but not handle them, the design will then be modified so that fish can move upstream through a narrow passage. Additional lights will allow us to count fish during low light periods.

After processing, fish will be placed in a protected recovery area upstream of the weir. The recovery location will be near a bank that's free from disturbances, partially fenced with cover and adequate flow, and adjacent to the processing area so that fish will not have to be transported. Once placed into the recovery area the fish will be allowed to re-enter the main section of the river and resume their migration at their own volition.

The weir was initially intended to operate from September through December, the primary migration time for adult chinook salmon. However, recently managers have expressed interest in operating the weir through spring to enumerate and collect biological information from steelhead, which may migrate upstream as late as April. Therefore, we will operate the weir September through April to enumerate both chinook salmon and steelhead. Enumerating steelhead in the Stanislaus River is considered a priority issue by many managers, since unlike chinook steelhead do not die after spawning and therefore cannot be counted in the river. Because of this there is currently no information on the number or timing of steelhead entering the Stanislaus River.

During the first year of operation we will also explore methods of enumerating fish which do not require handling, and which could also reduce future labor costs. Underwater video recording is one method which may allow for accurate counts without handling fish, and

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which may prove valuable at other locations with threatened or endangered species. The problem with using video equipment to record fish passage is that we are unable to collect scales and other biological information, so if video monitoring were employed in the future, it would likely be on an alternate basis with the physical catching and processing of fish.

Since some researchers have documented the reluctance of some species to move upstream through narrow constrictions and enter containment areas, it may be necessary to modify the weir passage opening, or enlarge the containment area. To reduce the risk of migration delays we will evaluate different weir passage and containment devices and select the ones that are most appropriate to conditions and species found in the Stanislaus River. At the onset of operation we will conduct daily snorkel surveys and count any fish below the weir. If numbers increase and fish are displaying a reluctance to migrate into the containment area, we will open the weir and allow the fish to pass, then modify the weir to try to reduce migration delays. We recognize that this could be a problem and will have back-up passage and containment plans ready for implementation.

Some researchers have also noted that complete weir counts can be difficult to obtain, especially if high flows prevent the operation of the weir for substantial periods of time. With the steering committee we will consider the value of marking adult chinook (not steelhead) that pass the weir such that mark recovery rates during carcass surveys could serve as a means of evaluating the effectiveness of the weir at catching fish.

Objective 3. Determine length frequency, age, sex, and stock composition of adult chinook salmon and steelhead entering the Stanislaus River.

Task 3.1 Measure length, identify sex, examine for marks, and collect scale and genetic samples as appropriate for all or a portion of the run.

We understand that there are serious management issues which need to be addressed when working with naturally produce chinook salmon and ESA protected steelhead. Therefore, fish handling and data collection procedures will be determined prior to weir operation during a facilitated process with CDFG, NMFS, USFWS, and the steering committee. We present different possibilities here to relate the unique opportunity to collect a substantial amount of biological information from a stock of chinook salmon which has had little hatchery influence, and on steelhead, a species which almost nothing is known about its abundance or life-history characteristics in the San Joaquin Basin.

Although there may be times when fish would only be counted, our desire is to process all fish such that a scale sample could be taken, and each fish could be measured, sexed, evaluated for disease and scarring, and rated for sexual maturity. In practice, we would expect

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to collect detailed biological information on only a random subsample of the run, especially where numbers are large. Sample rates would be sufficient to provide representative estimates and numbers would be based on statistical power analyses consistent with desired confidence levels. A portion of the fish could also be weighed. Scale samples from salmon and trout could be used to calculate growth rates and size and age at ocean entry. DNA could also be obtained from scales and used to determine relatedness to other California stocks.

Task 3.2 Estimate age and life history pattern from scale samples.

Significant information can be obtained through scale analyses, including age and life-history characteristics. DNA can also be obtained and used to evaluate relatedness to other Central Valley stocks. Since some scales are recovered during carcass surveys, we will only take scales from a portion of the chinook that pass the weir. The exact proportion of chinook that will be sampled for scales will be determined by the steering committee, but will probably be in the range of 3-5%.

Since steelhead are not recovered in carcass surveys, no scales have ever been recovered from steelhead in the Stanislaus River. Since scales would provide valuable information for our understanding of the life-history characteristics and future management of the species, we will sample a larger fraction of the population, perhaps 10-20%. The proportion sampled will be determined through consultations with NMFS and the steering committee. The value of scale collections from rainbow trout and steelhead is described further under Task 4.4.

Task 3.3 Maintain and disseminate comprehensive database of fish count and sample information.

Daily fish count and individual fish data will be entered into a computer database and entry will be verified. Consistent formats will be applied among years and documented to facilitate analysis. This data set will be available for distribution to agency, academic, or other parties for application to other analyses and syntheses.

Objective 4. Summarize and synthesize results of weir sampling.

Task 4.1 Provide means of validating carcass survey escapement estimates and calibrating carcass survey results should they differ from actual counts.

Since the weir will allow boats and debris to pass but will block the entire river to upstream migrating salmon, our catch rate should be nearly 100%, and will serve as a total count of adult salmon entering the Stanislaus River. We also have the option of marking a

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subsample of adults at the weir and using recaptures from carcass survey counts to determine the weir efficiency. Our timing and abundance determination will be compared to carcass survey estimates to evaluate the accuracy of the carcass survey. By monitoring the weir over different environmental conditions we may be able to determine what environmental factors are responsible for the difference in actual count and estimated abundance, which may enable us to develop a calibration factor for future carcass estimates. This calibration factor may also allow us to validate past escapement estimates. Since the weir will be operating near the mouth of the river, we will be able to monitor the response of salmonids to fall attraction flows and other environmental variables.

To help ensure that the weir is operating at full efficiency we will conduct weekly SCUBA and snorkel surveys of the weir to make sure it is structurally sound. Further, we will monitor fish response to the weir to make sure they are unable to pass through, but are not being harmed in their attempts. If injuries were being sustained in this way, we would be aware of it as those unsuccessful fish later passed through our processing area and showed signs of physical harm.

Task 4.2 Use known numbers of adult and juvenile salmon and steelhead each year to calculate smolt-per-spawner production rates and smolt-to-adult survival rates.

Screw traps have been used to collect data on outmigrating juvenile chinook and rainbow trout since 1993. Since 1998 traps have operated at both Oakdale (river mile 40) and Caswell (river mile 8) from late December through June. This extensive sampling period, coupled with frequent trap efficiency tests at both locations, has enabled managers to estimate the number of juvenile chinook that migrated past each trapping site, each year.

Adult and juvenile abundance estimates for the Stanislaus River would provide detailed status information on salmon and steelhead populations at various points in the life cycle. Partitioning of status by life stage makes it easier to identify the effects of limiting factors including freshwater rearing habitat and ocean survival. The Stanislaus population can serve as a useful indicator stocks for other salmon and steelhead populations in the San Joaquin basin.

Comparisons of numbers of spawners and smolts or other juveniles produced by that cohort of spawners provides information on the productivity and capacity of the freshwater rearing habitat. Density-dependent relationships between spawners and recruits and the relative importance of environmental variation can be identified with a time series of this data. Stock-recruitment relationships can potentially be derived for use in identifying optimum escapement levels and appropriate harvest levels. Smolt-per-spawner data can also be related to environmental conditions including flow and temperature management to provide

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an empirical basis for evaluating the benefits of various alternatives.

Comparisons of smolt numbers and adults produced at various ages by that smolt cohort provides information on downstream migration and ocean survival conditions. Corresponding smolt-to-adult survival rate estimates allow us to determine the extent to which status is determined by conditions outside the basin and to project the benefits of in-basin activities which affect the number of smolts produced.

Task 4.3 Analyze coded wire tag (CWT) data provided by weir samples to identify stray rates and origin of fish from other stocks and to determine contributions from different stock components tagged in the Stanislaus basin.

Coded wire tags are currently placed in a subsample of smolts released from hatcheries throughout the Central Valley. Analysis of coded wire tag recovery data is often limited by sample sample sizes but weir operation will maximize opportunities to sample CWT fish. Postponing recovery until carcass sampling allows the fish to spawn but can substantially reduce sample sizes because not all carcasses are recoverable. Decisions to sacrifice CWT fish at the weir will be made by the steering committee. If CWT's are not released inbasin, then all CWT fish would be strays and could be sacrificed without impacting the native stock. If the run is large, CWT fish might also be sampled without impacting net production. Alternatively, only males might be sacrificed because they are typically in surplus and do not limit net production.

CWT recoveries from other sources provide information on populations which contribute to the Stanislaus population. Comparisons of tag rates in the Stanislaus with tag rates in the source population provide an estimate of what proportion of the run includes strays from a given source. Straying information indicates to what degree the natural population is self-sustaining and helps provide a complete accounting of hatchery contributions in other hatchery evaluations.

CWT recoveries from release groups made within the Stanislaus basin would provide the means of evaluating the adult contribution of various life history stages. For instance, recovery rates of fry and smolt migrants could be compared to determine if pre-smolt migrants survive in significant numbers or if the population is driven by smolt numbers. These results would have significant implications for habitat and water management in the system. These analyses would probably not be feasible without the increased CWT sample rates provided by weir operation.

Task 4.4 Accurately determine status of rainbow trout/steelhead in the Stanislaus basin.

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The river likely contains rainbow that (1) remain close to their natal area throughout their life, (2) migrate substantial distances up and down the river to find advantageous habitat, and (3) migrate to the ocean and then return to spawn. All three life histories might be generated from the same population, and it is most likely that river migrants and ocean migrants are generated from the same population. It is currently unclear to what extent steelhead are produced by the system and how resident rainbow trout and steelhead populations are related. Scale and DNA samples collected at the weir will provide a systematic quantitative basis for resolving these questions.

Scales would be collected from rainbow trout captured at the weir and read to determine life-history. Scale patterns indicate time spent in freshwater and the ocean, the relative frequency of fluvial migrants compared to ocean migrants, and if fish repeatedly go from fresh to salt to fresh.

Genetic samples from scales would also be collected and compared to other Central Valley stocks. DNA samples are needed from fish that represent each of these life histories to determine the proportion of fish that are migratory and whether the ocean migrants are a distinct population. We will have to demonstrate (a) what the life history is for each fish sampled for DNA, and (b) that DNA is highly related between life histories. Further, in order to assess the risk of extinction (low or high) that the population faces, we will have to demonstrate the relative abundance of each life history type that might have distinct DNA. DNA analysis would be performed on a subsample of the scales collected by Dr. Jennifer Nielsen at the USGS. Scales from all sampled fish will be mounted and read by an independent laboratory, either at UC Davis or CSU Humboldt to determine total age, life-history, and age and size at ocean entry for steelhead.

Objective 5. Distribute weekly progress reports to keep other fisheries resource managers informed of our results and distribute final written report.

Our experience has taught us that there are significant benefits of keeping others informed of our progress on a regular basis. We will distribute written e-mail reports which explain important events and document the biological data. The weekly progress reports will also be kept on an internet site such that they can be viewed by anyone with internet access.

Since this will be the first resistance board weir constructed and implemented in California, we will go to considerable lengths to document the entire building process including the materials needed, their costs, and the labor required to construct the weir and monitor it throughout the season. This detailed documentation of the process will help other managers plan and implement a similar project successfully in the future.

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The detail of the design will include schematic diagrams of the weir such that the weir can be reproduced with the exact materials and to the exact dimensions. Digital photographs will be taken of the design, construction, and completed weir, including an itemized equipment list with the cost of each item. All information will be posted on the internet on a real-time basis, so that managers can track the progress and expenses of the project as it occurs. The information will also be included in a written report at the completion of the project.

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